REVIEW OF 'SPECTRAL GRAPH WAVELET BASED COMPONENT CLUSTERING FOR SYSTEM RELIABILITY ANALYSIS'

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ABSTRACT. This paper is a post-publication review of the article "Spectral Graph Wavelet based Component Clustering for System Reliability Analysis" presented at the *2018 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* in Bangkok, Thailand. The review summarizes the article and explains its overall strengths and impact. The article presents a novel contribution to the field of reliability analysis, but there are some questions about the results. This review raises points that need clarification in the article. Additional information on recent research is requested. And the methodology requires additional analysis. Finally, the proposed method should be compared to other methods of reliability analysis.

1. OVERALL SUMMARY OF THE ARTICLE AND ITS FINDINGS

This paper [1] proposes a method for system reliability analysis which clusters components using spectral graph wavelets in order to reduce the problem complexity. The paper's results are promising and advertise a significant reduction in the computational burden of reliability analysis.

2. OVERALL STRENGTHS OF THE ARTICLE AND ITS IMPACT IN THE FIELD

The paper is well-written, the topic is appropriate to the conference, the title clearly describes the methodology and application, and the article provides a good contribution to the field of system reliability analysis. But the paper lacks analytical depth and rigor and does not clearly explain why this is a sufficiently new finding. Consequently, the article is not suitable for a high-impact journal but can be submitted to a conference such as the *IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* after the following points are addressed.

3. MAJOR POINTS WHICH NEED CLARIFICATION, REFINEMENT, REANALYSIS, AND REWRITES

3.1. **Comments on Abstract.** The abstract clearly describes the goal of this research and provides the key result of computation time reduction. The

abstract also clearly explains that component clustering is the main methodology for reducing complexity and computational burden. The following points should be addressed.

(1) Almost half of the abstract section discusses the importance of the study. The background material in the abstract should be reduced and more information on the methodology of the study included.

(2) Additionally, the abstract advertises a computation effort reduction of "nearly 77%" but the actual results in Section III.b show a reduction of "nearly 98.3 %." I do not see a result of "nearly 77%" anywhere in the paper. This issue should be addressed as this casts doubt on the reliability of the method.

(3) "Clustering Methods" should be included as a keyword.

3.2. **Comments on Introduction.** The introduction makes the problem statement clear. Appropriate references are included which provide adequate background on what is already known about this topic. The references included are generally relevant to this topic and provide support for the background of this research. But there are some major flaws with the introduction that need to be addressed.

(1) Some more information on recent research is necessary, and the authors should include more information on the recent advances in graph learning methods. Only six of the seventeen references are within two years prior. The author mentions a recent "surge of researches on graph learning" (please fix the spelling error) but only cites four references from this "surge" and points readers to a highly cited literature survey which is already five years old. The author should re-examine the state-of-the-art and ensure the latest information is being cited and considered. Please include some articles from 2018.

(2) The introduction would benefit by including additional information about the results. The methodology is briefly described but does not state any results of the paper. Please elaborate on the paper's contributions in the Introduction section. Some bullet points can be included to list the major contributions. Furthermore, the paper does not sufficiently justify why the findings should be accepted/considered "new" or "novel." Please clearly explain the novelty and impact of this research.

(3) The introduction adequately describes the application of the method but does not mention any comparison with other methods. A comparison with other methods is important to inform whether the improvements offered by this method are competitive with other algorithms.

3.3. **Comments on Methodology.**

(1) The methodology is sufficiently clear, but additional analysis of the algorithm from a theoretical perspective would be helpful. For example, the authors should, in addition to presenting the numerical results, provide a theoretical analysis of the method and calculating

the expected results for comparison. The analysis should also include discussion of the primary parameters affecting the results. For example, the analysis should calculate the efficiency improvement as a function of the graph diameter and compare with the simulated results. Graphs of the calculated efficiency improvements versus various problem parameters would be a helpful addition to this paper.

3.4. Comments on Discussion and Conclusion.

(1) The discussion section is lacking. It only describes some basic philosophies relating to solving NP-complete problems. It is not made sufficiently clear how this relates to this research, and the discussion doesn't provide any meaningful takeaways or retrospection on the results of this method. This section should be significantly improved.

(2) The author mentions other graph learning methods in the Conclusion, such as random walk-based graph learning methods and encoder-decoder based graph learning methods. These methods are also existent in the literature. For example, another method of clustering for reliability analysis is given in [2]. The authors should compare their method with others. The experiment should be repeated with several competing methods and the results compared clearly in a table. Failure to compare with other methods contributes significantly to ambiguity related to the novelty or usefulness of the research.

(3) Likewise, the conclusion section lacks a good summary of the paper and results. It is only a simplified version of the abstract, stripped of important details. The conclusion should summarize the findings of this paper. Once the previous comments about adding more detailed theoretical analysis and results and comparing against other methods are implemented, the discussion and conclusions sections can be expanded in a meaningful way.

4. Minor points about figures/tables, references, typos, and other inconsistencies

(1) The abstract contains some grammatical irregularities that should be addressed (e.g., "few literatures" should be "few studies").

(2) The presentation of Figs. 2, 3, 4, and Table II can be improved. Please do not make Table II an image; it should be text, as in Table I.

(3) References should not be cited in the conclusion.

References

[1] P. Zhang and X. Zhu, "Spectral Graph Wavelet based Component Clustering for System Reliability Analysis," *2018 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM),* Bangkok, 2018, pp. 1135-1139, doi: 10.1109/IEEM.2018.8607637.

[2] Kile, Håkon, and Kjetil Uhlen, "Data reduction via clustering and averaging for contingency and reliability analysis," *International Journal of Electrical Power & Energy Systems* 43.1 (2012): 1435-1442.